

Table 3. Summary Evaluation of BDCP Conservation Element Bundles by Short-Listing Criteria Category

Conservation Element Bundles	SHORT-LISTING CRITERIA CATEGORY			
	Biological	Planning/Feasibility	Flexibility/Durability/Sustainability	Impacts to Other Resources
Water Operations and Conveyance Bundles				
1. Real-time operation of CVP/SWP	<ul style="list-style-type: none">• Low benefit associated with reduction in entrainment loss of smelt, salmonids, and splittail• Minimal effect on sturgeon	<ul style="list-style-type: none">• Depending on ability to conduct real-time operations, may be implemented to achieve covered activity goals• Funding and engineering feasibility is not a concern because does not involve any new construction• Sufficient knowledge regarding species behaviors to effectively conduct real-time operations may not be feasible in the near-term	<ul style="list-style-type: none">• Long-term could be constrained by climate change if hydrology changes and exports can no longer be met, could also be impacted by seismic activity and island subsidence• Provides minimal support for ecosystem processes compared to #3-#7• To the extent entrainment is a stressor, this bundle is highly adaptable at short and long time scales, and entirely reversible	<ul style="list-style-type: none">• Least likely of operations bundles (#1-#8) to affect other species inside or outside planning area (Delta)• Fewest impacts on human environment of operations bundles
2. Reduced demand/diversions	<ul style="list-style-type: none">• Moderate benefit to smelt, salmonids, and splittail based on reduced entrainment mortality and improved water quality and flow conditions• Minimal impact to sturgeon, although certainty is low• Benefits are highly dependent on amount of reduction	<ul style="list-style-type: none">• Would be contrary to SWP/CVP goals and therefore not meet planning goals; not a problem for Mirant• Reduced exports would have no capital costs• Costs of demand reduction programs and infrastructure unknown, but funding feasibility high	<ul style="list-style-type: none">• Reduced exports would reduce overall levee failure risk but long-term climate change and seismic and island subsidence still risks• Would provide minimal support for ecosystem processes compared to #3-#7• Reversible at household scale (though no reason to do so), but not at larger scale due to capital costs (e.g. desalinization plants)	<ul style="list-style-type: none">• Not likely to significantly affect other species inside or outside the planning area• Few impacts on human environment
3. Opportunistic exports	<ul style="list-style-type: none">• Low overall benefit to smelt based on both positive and negative effects• Moderate effect on sturgeon, salmonids, and splittail based on increased food, habitat, and hydrologic conditions	<ul style="list-style-type: none">• May (but, may not) meet SWP/CVP goals if much greater exports permitted during high flows; would meet Mirant's goals• Uncertain whether future hydrologic conditions would enable this option in long term• Feasibility likely less than #1 and #2, roughly same as #4-7 due to likely associated construction• Major expansion of pumping and storage facilities would be needed• Cost: \$100s M - \$B	<ul style="list-style-type: none">• Impacts and feasibility uncertain without engineering studies• Better flow and ecosystem process restoration than in #1, #2, #8• Adaptable to covered species needs but not easily reversible due to facility construction needs	<ul style="list-style-type: none">• Improve conditions for native aquatic species with restoration of fluctuating hydrology/salinity• Negative impacts to riparian, wetland, and terrestrial species from fluctuating salinity, change in farmland use, and new facilities construction south of Delta• Impacts on human environment due to construction, less than or similar to #4-7 depending on type and extent of storage projects

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4. SDA facility	<ul style="list-style-type: none"> Moderate benefit to smelt, salmonids, and splittail from increased food, habitat, and hydrologic conditions Low adverse effect to sturgeon based on false attractions flows, but low certainty (affects salmonids, too, but benefits outweigh adverse effect) Not likely to meet smelt needs due to time needed for implementation 	<ul style="list-style-type: none"> Would likely meet planning and export goals at same level as #5, #6, better than #1-#3, #7, #8 though possible impacts to covered fish by mixing Sacramento and SJ Rivers Many unknowns (e.g., fish screening, political) Cost analysis not completed, at least \$2-3B 	<ul style="list-style-type: none"> Levee integrity crucial to durability; seismic loading and sea-level rise must be considered Better flow restoration and more adaptable than #1-#3, #7-#8 Would require ongoing maintenance Not reversible due to major construction 	<ul style="list-style-type: none"> Restored hydrologic conditions and salinity fluctuation would improve conditions for native aquatic species, except in south Delta Negative impacts to riparian, wetland, and terrestrial species from fluctuating salinity, change in farmland use, and new facilities construction, more than #3 Human environment impacts due to construction, more than #3 Canal would create barrier to movement for terrestrial species
5. Isolated facility	<ul style="list-style-type: none"> High benefits to smelt, salmonids and splittail and moderate benefits to sturgeon associated with more natural Delta conditions Not likely to meet smelt needs due to time needed for implementation 	<ul style="list-style-type: none"> Would likely meet planning and export goals at same level as #5, #6, likely better than all others if river water mixing has negative impacts to fish Many unknowns (e.g., fish screening, political) Cost analysis not completed, at least \$2-3B 	<ul style="list-style-type: none"> Seismic loading and sea-level rise less a factor than for non-isolated bundles (#1-4 and 8); levee integrity not an issue Best flow and ecosystem process bundle, most adaptable for fish needs Would require ongoing maintenance Not reversible due to major construction 	<ul style="list-style-type: none"> Restored hydrologic conditions and salinity fluctuation would improve conditions for native aquatic species throughout planning area and downstream Negative impacts to riparian, wetland, and terrestrial species from fluctuating salinity, change in farmland use, and new facilities construction, more than #3 or #4 Human environment impacts due to major construction, more than #3, #4 Canal would create barrier to movement for terrestrial species
6. Bifurcated SDA facility	<ul style="list-style-type: none"> Low to moderate benefits to smelt, salmonids, and sturgeon and high benefits to splittail primarily associated with improved Delta conditions (hydrologic conditions, non-natives, food, habitat, and ecosystem processes) Moderate adverse effects from false attraction flows on sturgeon and salmonids, but offset by benefits of the action on these species Not likely to meet smelt needs due to time needed for implementation 	<ul style="list-style-type: none"> Would likely meet planning and export goals at same level as #4, #5, better than #1-#3, #7, #8 though possible impacts to covered fish by mixing Sacramento and SJ Rivers Many unknowns (e.g. fish screening, political) Hybrid between #4, #5, costs similar, \$2-3B 	<ul style="list-style-type: none"> Seismic loading and sea-level rise less a factor than for bundles without isolated conveyance component (#1-4 and 8); levee integrity less of an issue Impacts and feasibility uncertain without engineering studies Better flow and ecosystem process restoration than in #1, #2, #8 Would require ongoing maintenance Adaptable to covered species needs but not easily reversible due to major construction 	<ul style="list-style-type: none"> Restored hydrologic conditions and salinity fluctuation would improve conditions for native aquatic species throughout planning area, lesser extent than #5 Negative impacts to riparian, wetland, and terrestrial species from fluctuating salinity, change in farmland use, and new facilities construction, more than #3, similar to #5 Human environment impacts due to major construction, same as #5 Canals would create barrier to movement for terrestrial species

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7. Dual conveyance facility	<ul style="list-style-type: none"> Low benefit to splittail associated with reduced entrainment loss, increased habitat, and improved water quality offset by reduced flow conditions reduced flow conditions Moderate benefit to smelt associated with improved Delta conditions (hydrologic conditions, non-natives, food, habitat, and ecosystem processes) Low adverse effect on sturgeon from reduction in water quality due to dredging Not likely to meet smelt needs due to time needed for implementation 	<ul style="list-style-type: none"> Could meet SWP/CVP goals and Mirant goals Many unknowns (e.g. fish screening, political) Cost \$1.6-\$2.4B 	<ul style="list-style-type: none"> Levee integrity crucial to durability; seismic loading and sea-level rise must be considered; isolated conveyance component provides greater durability than #1-4 and #8) Less flow and ecosystem benefits than fully isolated facilities More adaptable than #1-2, #8 for covered species needs but not easily reversible due to major construction 	<ul style="list-style-type: none"> Restored hydrologic conditions and salinity fluctuation would improve conditions for native aquatic species throughout planning area, lesser extent than #5 Negative impacts to riparian, wetland, and terrestrial species from fluctuating salinity, change in farmland use, and new facilities construction, more than #3, similar to #5 Human environment impacts due to major construction, greatest of #1-8 Canals would create barrier to movement for terrestrial species
8. San Joaquin River Corridor Isolated	<ul style="list-style-type: none"> Adverse effect on smelt from increased hydrologic residence time and timeframe needed for implementation Effect on sturgeon is unknown, but possibly adverse Low benefit to salmonids based on food supply and emigration from San Joaquin River (fall-run Chinook and steelhead only) No net benefit to splittail 	<ul style="list-style-type: none"> Could meet SWP/CVP goals and Mirant Engineering feasible \$0.75-\$1.75 B construction costs; ongoing operation costs unknowns, millions per year 	<ul style="list-style-type: none"> Levee integrity crucial to durability; seismic loading and sea-level rise must be considered risks Would improve flows and ecosystem processes in SJ River but not elsewhere in Delta Not adaptable; reversibility low, but better than other bundles #4-7 	<ul style="list-style-type: none"> Improvements to habitat in SJ River and south Delta, lesser than #3-7 No effects to species outside Delta Localized negative impacts to riparian and terrestrial species from construction Some human environment impacts due to construction, less than #3-7
Entrainment and Predation Mortality Reduction Bundles				
9. Minimize SWP/CVP mortality	<ul style="list-style-type: none"> Negligible/no impact to smelt, salmonids, and splittail Unknown impact to sturgeon, but possible decrease in entrainment 	<ul style="list-style-type: none"> Less likely to achieve water supply goals than (#4-7) but more likely than #10-13 Feasible, well known mechanisms Capital costs \$5-10M but low confidence on estimate 	<ul style="list-style-type: none"> Seismic loading and sea-level rise must be considered Does not improve ecosystem process Short-term adaptability, not known long-term Almost completely reversible, rapidly 	<ul style="list-style-type: none"> Beneficial, more than #10-11, for native aquatic species in Delta; no effects outside Delta Relatively minor human environment impacts
10. Minimize non-SWP/CVP entrainment	<ul style="list-style-type: none"> Low benefit to smelt based primarily on entrainment and flow conditions Low benefit to sturgeon and splittail from reduced entrainment Net negligible effect to salmonids and splittail 	<ul style="list-style-type: none"> Less likely to achieve SWP/CVP goals than #4-7, but likely to enable Mirant to achieve both its sets of goals (operations and conserving covered fish) Very feasible, well known technology; dependent on willingness of other water users to participate Costs \$20-70M, but low confidence on estimate 	<ul style="list-style-type: none"> Design with seismic loading and sea level rise in mind, but minimal concern overall Does not support ecosystem processes Not highly adaptable; moderately reversible 	<ul style="list-style-type: none"> Like #9, but smaller impacts because fewer facilities Relatively minor impacts on human environment impacts

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11. Reduce predation	<ul style="list-style-type: none"> Low benefit to smelt and salmonids primarily from reduction in non-native predation and improved water quality and hydrologic conditions Unknown impacts on sturgeon, but possible marginal benefit Moderate benefit to splittail from increased habitat and reduced non-native predation 	<ul style="list-style-type: none"> Only addresses one source of mortality; would not likely enable SWP/CVP to meet their goals Fairly easy engineering and relatively low cost 	<ul style="list-style-type: none"> Effects of sea level rise, seismic events, and levee failures could include loss or alteration of the habitat, but low magnitude of effects Does not improve ecosystem processes Adaptable if good monitoring, relatively easily reversible 	<ul style="list-style-type: none"> Beneficial effects on native aquatic species to lesser extent than #9; no effects outside Delta Human environment impacts temporary and localized
12. Isolate gravel pits	<ul style="list-style-type: none"> Minimal or no effect on smelt and sturgeon Low benefit to salmonids and splittail primarily associated with reduced predation by non-natives Effects will be greatest on San Joaquin River, where most gravel pits are located 	<ul style="list-style-type: none"> Only addresses one source of mortality; would not likely enable SWP/CVP to meet their goals Fairly easy engineering but chances of success not known Could cost \$ Millions per project 	<ul style="list-style-type: none"> Unlikely to be affected by climate change or seismic events Does not address ecosystem processes Not easily adaptable or reversible, but not likely to need to be reversed 	<ul style="list-style-type: none"> Only minor effects on other species in Delta; no effects outside Delta Moderate human environment impacts from construction, less than #9-10, more than #11,#13
13. Install screens on river diversions	<ul style="list-style-type: none"> Negligible impacts to all species 	<ul style="list-style-type: none"> Less likely than #4-7 to achieve SWP/CVP goals, depends on voluntary participation Screening techniques well known Cost: \$45-100M, or ~\$1m per screen 	<ul style="list-style-type: none"> Unlikely to be affected by climate change or seismic events Does not address ecosystem processes Not easily adaptable or reversible, but not likely to need to be reversed 	<ul style="list-style-type: none"> Not likely to affect other species in Delta; could have minor positive effect on entrained fish upstream Human environment impacts temporary and localized
Flow-Related Habitat Improvement Bundles				
14. Improve DCC operations	<ul style="list-style-type: none"> Negligible impact on smelt Negligible additional benefit to sturgeon because gates are currently open during juvenile outmigration Negligible additional impact to salmonids because gates are currently operated primarily for their benefit Low benefit to splittail from improved flow conditions and water quality 	<ul style="list-style-type: none"> Not alone likely to enable SWP/CVP to meet their goals; no effect on Mirant Feasible and very low capital costs 	<ul style="list-style-type: none"> Operation would not be effected by seismic events, sea level rise, or levee failures, but management could change Does not address ecosystem processes Easily adaptable and reversible 	<ul style="list-style-type: none"> Not likely to have effects on other species inside or outside Delta If higher salinities result, there could be some agricultural land loss and water treatment costs
15. Screen and open the DCC	<ul style="list-style-type: none"> Negligible impact on smelt Low adverse effect on sturgeon associated with reduced access to food and habitat in interior Delta Moderate benefit to salmonids associated with high survival from reduced passage into interior Delta Low adverse effect on splittail associated with reduced water quality and flow conditions 	<ul style="list-style-type: none"> Not alone likely to enable SWP/CVP to meet their goals; no effect on Mirant DCC feasible with no capital costs; screens challenging but feasible, may be \$500M 	<ul style="list-style-type: none"> Seismic events should be considered when designing screens, but operations would not be effected by seismic, sea level rise, or levee failures; management could change Does not address ecosystem processes Adaptable and reversible, but expensive to reverse 	<ul style="list-style-type: none"> Not likely to have effects on other species inside or outside Delta Local impacts on human environment impacts due to construction of new facility

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16. Re-operate storage facilities	<ul style="list-style-type: none"> Negligible benefit to smelt associated with improved Moderate benefit to salmonids and high benefits to sturgeon and splittail primarily associated with improved food, flow, water quality, and habitat 	<ul style="list-style-type: none"> Could reduce amount of water available for export and therefore fail to meet SWP/CVP goals Feasible but could be constrained by downstream legal and physical factors No additional capital costs 	<ul style="list-style-type: none"> Hydrology changes (e.g., associated with climate change) could affect ongoing implementation; would require ongoing operation and maintenance Would restore historic flows that supported fish and their habitats Highly adaptable and easily reversible 	<ul style="list-style-type: none"> Benefits to species upstream; minor distribution changes of species in Delta due to hydrological changes No human environment impacts likely Socioeconomic impacts only if reduced exports
17. Improve and create bypass and floodway habitat	<ul style="list-style-type: none"> Negligible benefit to smelt Moderate benefit to sturgeon and salmonids and high benefits to splittail primarily associated with reduction in non-natives, improved water quality, and increased habitat and food Among the elements that will provide highest benefit to splittail 	<ul style="list-style-type: none"> Could improve reliability of exports slightly, but not alone likely to enable SWP/CVP to meet their goals Feasibility not readily known without specific projects; geographic, political, land use constraints \$5800 per acre average cost of restoration 	<ul style="list-style-type: none"> Sea level rise would need to be considered Would restore ecosystem process for fish but would require ongoing maintenance and management.. Moderately adaptable; reversing improvements possible but not practical 	<ul style="list-style-type: none"> Benefits to aquatic and other species inside and outside Delta; greater benefits than #14-17. Large impacts to human environment, especially socioeconomic from land sales and use conversion
Physical Habitat Restoration Bundles				
18. Restore habitat in the north, east, and west Delta	<ul style="list-style-type: none"> High benefit to smelt, sturgeon, and splittail primarily associated with improved food, habitat, and ecosystem processes Low benefit to salmonids, but would be greatly enhanced if implemented in tandem with #22 Among the elements that will provide highest benefit to splittail 	<ul style="list-style-type: none"> Does not directly help achieve export goals but could ease regulatory restrictions, enabling achievement of goals Many challenges, including landownership and technical Costs highly variable; between \$70,000-280,000 per mile, \$500-2000 per acre; full Delta restoration several \$B 	<ul style="list-style-type: none"> Should consider effects of sea level rise, seismic events, and levee failures Adaptability uncertain Reversibility impractical and unlikely 	<ul style="list-style-type: none"> Substantial improvements for aquatic and other species inside and outside Delta; negative impacts to species that forage in ag lands or prefer freshwater Greater impacts than #19-20 Habitat creation on existing levees no human environment impact Levee setbacks would be associated with high human environment impacts, and socioeconomic impacts due to loss of ag land
19. Restore habitat in the central Delta	<ul style="list-style-type: none"> Similar effects to smelt, salmonids, and splittail as #18, but lower because lower quality and quantity of habitat Similar effects to sturgeon as #18 Benefits to salmonids would be greatly enhanced if implemented in tandem with #22 	<ul style="list-style-type: none"> Does not directly help achieve export goals but could ease regulatory restrictions, enabling achievement of goals; lesser magnitude than #18 Many challenges, including landownership and technical; island restoration more difficult for #19 than #18 or #20 because more subsidence in central Delta Costs highly variable; unit costs higher than for #18 due to more challenges with subsidence 	<ul style="list-style-type: none"> Should consider effects of sea level rise, seismic events, and levee failures Adaptability uncertain Reversibility impractical and unlikely 	<ul style="list-style-type: none"> Substantial improvements for aquatic and other species inside and outside Delta, better than #18 for waterfowl; negative impacts to species that forage in ag lands or prefer freshwater Less impacts than #18 Habitat creation on existing levees would have no human environment impact Levee setbacks would be associated with high human environment impacts, and socioeconomic impacts due to loss of ag land; lesser magnitude than #18

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20. Restore habitat in the south Delta	<ul style="list-style-type: none"> Similar to but lower benefits to smelt as #18, 19, & 21 because lower quality habitat Similar to but lower benefits to sturgeon as #18 & 19 because lower abundance of sturgeon in south Delta Similar to but lower benefits to salmonids because only fall-run Chinook and steelhead are found in San Joaquin River Similar to but lower benefits to splittail as #18 because of lower quantity and quality of habitat Benefits to salmonids would be greatly enhanced if implemented in tandem with #22 	<ul style="list-style-type: none"> Does not directly help achieve export goals but could ease regulatory restrictions, enabling achievement of goals; lesser magnitude than #18 Many challenges, including landownership and technical Costs highly variable; between \$70,000-280,000 per mile, \$500-2000 per acre; lower cost than #18 Delta restoration due to smaller area 	<ul style="list-style-type: none"> Should consider effects of sea level rise, seismic events, and levee failures Adaptability uncertain Reversibility impractical and unlikely 	<ul style="list-style-type: none"> Substantial improvements for aquatic and other species inside and outside Delta; negative impacts to species that forage in ag lands or prefer freshwater Less impacts than #18 Habitat creation on existing levees no human environment impact Levee setbacks would be associated with high human environment impacts, and socioeconomic impacts due to loss of ag land
21. Restore Suisun Marsh habitat	<ul style="list-style-type: none"> Similar benefits to smelt as #18, but greater than 19 & 20 because high quality habitat Low benefits to sturgeon and salmonids primarily associated with improved food and habitat conditions High benefits to splittail from improved Delta conditions Benefits to salmonids would be greatly enhanced if implemented in tandem with #22 	<ul style="list-style-type: none"> Does not directly help achieve export goals but could ease regulatory restrictions, enabling achievement of goals Technically feasible, depends on landowner willingness Cost depends on extent; \$37-\$52M likely 	<ul style="list-style-type: none"> Should consider effects of sea level rise, seismic events, and levee failures Adaptability uncertain Reversibility impractical and unlikely 	<ul style="list-style-type: none"> No effects on other species in the Delta, but enhanced habitat for species outside the Delta Human environmental impacts from construction moderate, and socioeconomic impacts from loss of ag land and duck clubs local to regional
22. Restore habitat upstream of Delta	<ul style="list-style-type: none"> Negligible impact to smelt High benefit to sturgeon associated with water quality, habitat, and food Greatest benefit to salmonids of all element bundles associated with reduced non-native predation and improved flow, habitat, food, and ecosystem processes High benefits to splittail specifically from floodplain restoration (similar to #17) 	<ul style="list-style-type: none"> Does not directly help achieve export goals but could ease regulatory restrictions, enabling achievement of goals Some technical, landownership challenges and socioeconomic effects Costs will vary, but could total \$230-390M 	<ul style="list-style-type: none"> Should consider effects of sea level rise, seismic events, and levee failures Adaptability uncertain Reversibility impractical and unlikely 	<ul style="list-style-type: none"> No effects on other species in the Delta, but enhanced habitat where implemented Human environmental impacts from construction low and localized